Risk Factors of Gestational Diabetes Mellitus in a Reference Maternal Health Care Centre in Southern Benin

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Abstract Gestational diabetes mellitus is the most commonly observed endocrine disorder during pregnancy. It results in severe fetal and maternal complications that can increase the fetal morbidity and mortality and the risk for overt diabetes in women. Identification of pregnant women at high risk for gestational diabetes mellitus is therefore needed for early detection in order to reduce its consequences for the mother, the fetus and the newborn. The objective of the study was to identify risk factors for gestational diabetes in a reference maternal health care centre in southern Benin. This was a case-control study carried out from 1st February 2015 to 31st July 2017 in reference maternal health care centre at the University Hospital of Porto-Novo. All pregnant women with a gestational age of 24 to 28 weeks of amenorrhea, who utilized antenatal care service of University Hospital of Porto-Novo, were screened for gestational diabetes mellitus. The chi-square test was used to identify risk factors for gestational diabetes mellitus. The statistical significance was fixed at $p < 0.05$. Of the 967 pregnant women participated in the study, 73 cases of gestational diabetes mellitus, were detected (7.5%). Risk factors of gestational diabetes identified were: maternal age ≥ 35 years [OR 7.82 CI 95% (4.75-12.89)], body mass index ≥ 25 kg/m^2 [OR 9.56 CI 95% (5.17-17.70)], family history of diabetes at 1st degree [OR 2.78 CI 95% (1.53-5.06)], a history of fetal macrosomia [OR 7.25 CI 95% (3.11-16.92)], a history of stillbirth [OR 2.98 CI 95% (1.78-5.00)], an antecedent of more than two spontaneous miscarriages [OR 1.93 CI 95% (1.19-3.12)] and the personal history of hypertension [OR 3.91 CI 95% (1.52-10.07)]. This study confirmed the influence of maternal age and some medical and obstetric histories as risk factors of gestational diabetes mellitus. These pregnant women at high risk of gestational diabetes mellitus should benefit from early detection.

Keywords Gestational Diabetes Mellitus, Risk Factors, WHO Test

1. Introduction

Gestational diabetes mellitus (GDM) is defined as any level of glucose intolerance with onset or first recognition during pregnancy in a woman with no evidence of diabetes or dysglycemia in the past time [1]. GDM is considered as the most commonly endocrine disorder observed during pregnancy, making it a high-risk pregnancy with both maternal, fetal and neonatal complications [2-5]. It results in severe fetal and maternal complications that can increase the fetal mortality and morbidity [6] and the risk for overt diabetes in women [7, 8]. The prevalence of GDM is increasing worldwide. Yearly 21 million cases of the world are reported. GDM is more common in developing countries [9] due to decreasing levels of physical activity, changes in dietary patterns and increasing.

Therefore, identifying GDM risk factors for early detection is the key that may inform preventives measures to be taken timely to ensure satisfactory outcome of pregnancy [6]. The objective of the study was to identify risk factors for GDM in a reference maternal health care centre in southern Benin.

2. Materials and Methods

The case-control study was carried out at the maternal health care unit of the University Hospital of Porto-Novo, one of the largest reference hospitals in southern Benin. The study was conducted over a period of thirty (30) months from February 1rst, 2015 to July 31th, 2017. Screening test for GDM was performed for pregnant women between 24 and 28 weeks of amenorrhea. Pregnant women with evidence of diabetes or dysglycemia before or at the beginning of their pregnancy were excluded from the study. Informed consent or parental consent for pregnant women under 18 years of age was obtained prior to data collection. An appropriate

blood collection room was prepared in the maternal health care service. Biochemical analyses of drawn blood samples were performed at the hospital laboratory. Blood glucose was measured by the glucose oxidase method [10] in the plasma of fasting subjects.

The screening was done according to the World Health Organization (WHO) test. Participants were asked to undergo for Oral Glucose Tolerance Test. All antenatal care attendees were given 75gm of glucose per 100 ml of distilled water. The blood samples were collected after two hours' time for serum glucose levels. The serum glucose value exceeding 1.40g/l was declared as a case of GDM [11]. Thus, "Cases" were represented by pregnant women with blood glucose levels ≥ 1.40 g/l and "Controls" refers to pregnant women with blood glucose levels < 1.40 g/l. The independent variables studied were: maternal age, socio-demographic profile, body mass index prior to pregnancy, medical and obstetric history. Data on independent variables were collected by documentary review. The dependent variable was the GDM. For the comparison of the results, we used the chi-square test and the difference was assumed to be statistically significant for a p less than 0.05.

2.1. Statistical Analysis

Statistical analysis was done by using SPSS software application version 16. Proportions were calculated. Odds ratio were calculated with 95% confidence interval to identify risk factors of GDM. Statistical significance level was set at p <0.05.

2.2. Ethical Considerations

The objectives of the study were explained to participants. Voluntary informed oral consent was obtained from each participating woman before starting blood collection. This consent claims that participants were not at risk by refusing to participate in the survey or stopping their collaboration during the study and would not have their maternity care impacted in any way prior to commencing the blood collection. The confidentiality of the data and the anonymity of the pregnant were respected.

3. Results

Among 967 pregnant women screened, 73 (7.5%) cases of GDM were identified. The remaining 894 pregnant women

were considered as "Controls".

3.1. Characteristics of the Sample

3.1.1. Age of the Participants

The mean age of the study population was 28.47 ± 5.71 years (33 ± 4.19 years in case group vs 28 ± 5.66 years in control group) and ranged from 16 to 44 years. Prevalence of GDM increased significantly from 35 years of age (p = 0.0039) (Figure 1).
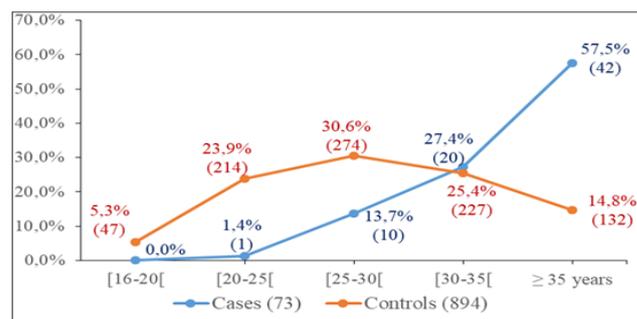

Figure 1. Age of women « Case » and « Controls » at university hospital of Porto-Novo, Benin, 2015-2017

3.1.2. Occupation, Education and Marital Status of Pregnant Women

Occupation, education and marital status of pregnant women were not associated with GDM (Table 1).

3.2.2. Obstetric History of Pregnant Women

Stillbirths, fetal macrosomia and more than two spontaneous miscarriages conditions were statistically more prevalent in pregnant with GDM (Table 2).

3.2.3 Pregnant Women's Family and Individual Medical Histories

GDM was statistically associated with an individual history of high blood pressure, body mass index, and family history of first-degree diabetes (Table 3).

3.2.4. Risk Factors of Gestational Diabetes Mellitus

Risk factors for gestational diabetes mellitus identified were: maternal age ≥ 35 years, body mass index ≥ 25 kg / m^2, family history of first degree diabetes, history of fetal macrosomia, stillbirth, more than two spontaneous miscarriages, and personal history of high blood pressure (Table 4).

Table 1. Occupation, education and marital status of "Case of GDM" and "Control" at university hospital of Porto-Novo, Benin, 2015-2017

Variables	Total n (%)	GDM Cases n (%)	Controls n (%)	p
Occupation				0.2894
Businesswoman / Saleswoman	383 (39.6)	26 (35.6)	357 (40.0)	
Housewife	204 (21.1)	12 (16.5)	192 (21.5)	
Government staff	160 (16.6)	16 (21.9)	144 (16.1)	
Artisan/Workers	130 (13.4)	9 (12.3)	121 (13.5)	
Pupil / Student	90 (9.3)	10 (13.7)	80 (8.9)	
Education				0.1720
Illiterate/Primary	450 (46.5)	30 (41.1)	420 (47.0)	
Secondary school	296 (30.6)	20 (27.4)	276 (30.9)	
University	221 (22.9)	23 (31.5)	198 (22.1)	
Marital status				0.1487
Married	740 (76.5)	51 (69.9)	689 (77.1)	
Widowed	124 (12.8)	7 (9.6)	117 (13.1)	
Single	103 (10.7)	15 (20.5)	88 (9.8)	
Total	**967**	**73**	**894**	

GDM: Gestational diabetes mellitus

Table 2. Distribution of pregnant "GDM Case" and "Controls" women by obstetric history at university hospital of Porto-Novo, Benin, 2015-2017

Variables	Total n (%)	GDM cases n (%)	Controls n (%)	p
Number of pregnancies				0.2123
1	147 (15.2)	6 (8.2)	141 (15.8)	
2-3	474 (49.0)	37 (50.7)	437 (48.9)	
4 and over	346 (35.8)	30 (41.1)	316 (35.3)	
Number of delivery				0.1099
0	174 (17.9)	8 (10.9)	166 (18.6)	
1	253 (26.2)	17 (23.3)	236 (26.4)	
2-3	399 (41.3)	37 (50.7)	362 (40.5)	
4 and over	141 (14.6)	11 (15.1)	130 (14.5)	
Other obstetric history				
Stillbirths				**0.18×10^{-4}**
Yes	158 (16.3)	25 (34.2)	133 (14.9)	
No	809 (83.7)	48 (65.8)	761 (85.1)	
Spontaneous miscarriages (> 2)				**0.0069**
Yes	301 (31.1)	33 (45.2)	268 (30.0)	
No	666 (68.9)	40 (54.8)	626 (70.0)	
Fetal macrosomia				**0.13×10^{-5}**
Yes	26 (2.7)	9 (12.3)	17 (1.9)	
No	941 97.3)	64 (87.7)	877 (98.1)	
Total	**967**	**73**	**894**	

GDM: Gestational diabetes mellitus

Table 3. Distribution of GDM cases and controls by family history and individual medical history at university hospital of Porto-Novo, Benin, 2015-2017

Variables	Total n (%)	GDM Cases n (%)	Controls n (%)	p
Individual medical history				
High blood pressure				**0.0024**
Yes	26 (2.7)	6 (8.2)	20 (2.2)	
No	941 (97.3)	67 (91.8)	874 (97.8)	
BMI				**0.0000**
[18.5 - 25[	614 (63.5)	13 (17.8)	601 (67.2)	
[25 - 30[	220 (22.7)	19 (26.0)	201 (22.5)	
30 and over	133 (13.8)	41 (56.2)	92 (10.3)	
Family medical history				
First-degree diabetes				**0.0005**
Yes	98 (10.1)	16 (21.9)	82 (9.2)	
No	869 (89.9)	57 (78.1)	812 (90.8)	
High blood pressure				0.1079
Yes	73 (7.5)	9 (12.3)	64 (7.2)	
No	894 (92.5)	64 (87.7)	830 (92.8)	
Total	**967**	**73**	**894**	

GDM: Gestational diabetes mellitus

BMI: Body mass index

Table 4. Risk factors for gestational diabetes mellitus at university hospital of Porto-Novo, Benin, 2015-2017

Risk factors	GDM Cases	Controls	OR	CI 95%	p
Maternal age $\geq$ 35 years	42/73	132/894	7.82	4.75-12.89	**0.0000**
Body mass index $\geq$ 25 kg/m^2	60/73	291/894	9.56	5.17-17.70	**0.0000**
First degree family diabetes	16/73	82/894	2.78	1.53-5.06	**0.0005**
Individual high blood pressure	6/73	20/894	3.91	1.52-10.07	**0.0024**
Antecedent of fetal macrosomia	9/73	17/894	7.25	3.11-16.92	**0.13 x 10^{-5}**
Antecedent of stillbirth	25/73	133/894	2.98	1.78-5.00	**0.18 x 10^{-4}**
Antecedent of spontaneous miscarriages (> 2)	33/73	268/894	1.93	1.19-3.12	**0.0069**

GDM: Gestational diabetes mellitus

OR: Odds Ratio, CI 95%

CI: Confidence interval

4. Discussion

4.1. Prevalence of Gestational Diabetes Mellitus

Gestational diabetes mellitus was a frequent condition in antenatal cares attendees at the University Hospital Center of Porto-Novo with a prevalence of 7.5%. According to the other studies carried out in Cotonou in southern Benin, the prevalence of gestational diabetes has doubled in less than 30 years: 3.2% in 1988 [12], 4.4% in 1998 [13] and 6.5% in 2013 [14]. Globally, the prevalence of gestational diabetes mellitus in the world varies between 3 and 15% [14-17] with disparities from one continent to another. In Africa, a few studies have reported a prevalence of gestational diabetes varying from 5 to 17% [18-20]. In the United States, this prevalence doubled from 1.5% in1989-1990 to 4.2% in 2001-2004 [21]. In France, the prevalence of gestational diabetes varies from 2 to 6% [22, 23].

Once considered a rare disease in Africa, the incidence of diabetes and particularly of gestational diabetes mellitus is growing in African countries [18-20]. The increasing prevalence in developing countries is related to decreasing levels of physical activity, changes in dietary patterns (transitional nutrition) and increasing rate of obesity [24].

4.2. Risk Factors of Gestational Diabetes Mellitus

Several strategies for the detection of GDM are proposed to be done most often between 24 and 28 weeks of amenorrhea. Early detection by fasting glucose in the first trimester of pregnancy is recommended if any of the following risk factors are present: mother age $\geq$ 35 years, overweight (BMI $\geq$ 25 kg / m^2), first-line family history of type 2 diabetes, personal history of gestational diabetes mellitus or fetal macrosomia [23, 25, 26].

4.2.1. Mother Age

The average age of pregnant women with GDM in the present report was 33 ± 4.19 years compared with 28 ± 5.66 years in the control group. The proportion of pregnant women with GDM was significantly higher at a maternal age of 35 years [p <0.05; OR 7.82 CI 95% (4.75-12.89)]. Maternal age has thus been an important factor in the detection of gestational diabetes as reported in the literature. Indeed, the average age of pregnant women with gestational diabetes is generally between 31 and 35 years [26-27].

4.2.2. Body Mass Index

Pregnancy overweight defined by a body mass index ≥ 25 kg/m^2 is recognized by all authors as a risk factor for gestational diabetes [26-29]. In the present study, overweight was associated with GDM [p <0.05; OR 9.56 CI 95% (5.17-17.70)].

4.2.3. Family History of 1st Degree Gestational Diabetes Mellitus

A history of first-degree family diabetes was found in 21.9% of pregnant with GDM compared with 9.2% in the control group (p <0.05). There was a relationship between first-degree family diabetes and GDM [OR 2.78 CI 95% (1.53-5.06)]. Our results were consistent with those reported in scientific literature [19, 29].

4.2.4. Other Risk Factors of Gestational Diabetes Mellitus

Other risk factors of GDM observed were a personal history of hypertension, histories of more than two spontaneous miscarriages, stillbirth and fetal macrosomia. These factors are reported in the literature as risk factors for GDM and should prompt health care providers to screen early pregnant [23, 29]. Characteristics such as socioeconomic status and multi-deliveries did not appear to be independent risk factors for GDM. This is consistent with the results of the series (p> 0.05). In fact, the multiplicity of risk factors and their interactions make the individual risk prediction complex [19-23, 25-29]. Note that the relationship between number or deliveries and GDM is closely related to two potential confounders that are age and body mass index. Indeed, as number of deliveries increases, women being more likely to be elderly and overweight or obese [23, 27, 29].

The limitations of this study are due to the fact that the "Control group" was not matched with the "GDM Cases" for any characteristics. However, the results generated by the study are in agreement with the data from the scientific literature.

5. Conclusions

Results showed that maternal age ≥ 35 years, body mass index ≥ 25kg/m^2, history of first degree family diabetes, personal history of hypertension, and obstetric history of more than two spontaneous miscarriages, fetal macrosomia and stillbirths were risk factors of GDM. Early detection is desirable for these groups of pregnant women in order to implement timely appropriate therapeutics.

Conflict of Interest

None

Acknowledgements

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